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*IN THE UNITED STATES PATENT AND TRADEMARK OFFICE*

In re application of: Jayaraman, et al.

Attorney Docket No.: TRIPP033

Patent: 6,798,288 B1

Issued: September 28, 2004

Title: RECEIVE BAND REJECTION FOR A DIGITAL RF AMPLIFIER

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first-class mail on November 17, 2004 in an envelope addressed to the Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.

Signed: ______________________
Aurelia M. Sanchez

**REQUEST FOR CERTIFICATE OF CORRECTION
OF OFFICE MISTAKE
(35 U.S.C. §254, 37 CFR §1.322)**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
Attn: Certificate of Correction



Dear Sir:

Attached is Form PTO-1050 (Certificate of Correction) at least one copy of which is suitable for printing. The errors together with the exact page and line number where they occur, and shown correctly in the application filed, are as follows:

**SPECIFICATION:**

1. Column 4, line 24, change "an LS antenna" to --an antenna--. This appears correctly in the patent application as filed on page 6, line 13-14.

2. Column 5, line 36, change "and 77 turns" to --and T2 turns--. This appears correctly in the patent application as filed on page 7, line 35.

3. Column 5, line 58, change "pattern ie is generated" to --pattern generated--. This appears correctly in the patent application as filed on page 8, line 15-16.

4. Column 5, line 59, change "T1 and T7" to --T1 and T2--. This appears correctly in the patent application as filed on page 8, line 16.

5. Column 6, line 10, change “the act that” to --the fact that--. This appears correctly in the patent application as filed on page 8, line 30.

**CLAIMS:**

1. In line 4 of claim 2 (column 15, line 43) change “noise shaving” to --noise shaping--. This appears correctly in Amendment A as filed on page 3, paragraph 1, line 1 – old claim 6.

2. In line 4 of claim 15 (column 17, line 18) change “noise shaving” to --noise shaping--. This appears correctly in Amendment A as filed on page 6, paragraph 2, line 1 – old claim 23.

3. In line 2 of claim 26 (column 20, line 9) change “modifying associated” to --modifying capacitance associated--. This appears correctly in Amendment A as filed on page 10, paragraph 1, line 3-4.

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Patentee hereby requests expedited issuance of the Certificate of Correction because the error lies with the Office and because the error is clearly disclosed in the records of the Office. As required for expedited issuance, enclosed is documentation that unequivocally supports the patentee's assertion without needing reference to the patent file wrapper.

It is noted that the above-identified errors were printing errors that apparently occurred during the printing process. Accordingly, it is believed that no fees are due in connection with the filing of this Request for Certificate of Correction. However, if it is determined that any fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 500388 (Order No. TRIPP033).

Respectfully submitted,
BEYER WEAVER & THOMAS, LLP

Haruo Yawata
Limited Recognition under 37 CFR § 10.9(b)

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DEC 03 2004

Fig. 15 is a plot illustrating a transmit spectrum of the communication system according to a specific embodiment of the present invention.

## DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Various embodiments of the present invention will now be described in detail with reference to the drawings, wherein like elements are referred to with like reference labels throughout.

Referring to Fig. 1, a simplified block diagram of a cell phone 10 designed according to the present invention is shown. Cell phone 10 includes an RF block 12, a modulation and demodulation block 14, a controller block 16 including DSP, RAM, user interface, baseband circuitry configured to generate a baseband signal, and other standard circuitry used in a cell phone, a duplexor or a T/R (transmit/receive) switch 18 (a duplexor is used for cell phones that transmit and receive at the same time, and a T/R switch is used for cell phones that either transmit or receive alternately), and an antenna 20. For the sake of simplicity, the block 18 is collectively referred to as the "duplexor" in the specification. During transmission, the baseband circuitry in controller 16 is responsible for generating a baseband signal, which is typically a string of bits representative of the information to be transmitted. The baseband signal is then modulated in box 14 with an intermediate frequency (IF) modulation signal which is then provided to RF block 12. Since the functionality of the modulation and demodulation block 14, the controller 16, the duplexor 18 and the antenna 20 are all well known in the art, a detailed description of each is not provided herein.

The RF block 12 includes an IF to RF mixer 30 for generating an RF signal (*e.g.*, 825 MHz) from the modulated signal received from the controller 16 through the modulator 14, a matching network (MN) 32, a power amplifier (PA) 34 configured to amplify the RF signal, and another matching network (MN) 36. During transmission, the amplifier 34 amplifies the RF signal and provides it to the antenna 20 via the matching network 36 and the duplexor 18. On the receive side, RF block 12 includes a matching network 40 configured to receive an RF signal (e.g., 870 MHz) received by antenna 20, a low noise amplifier (LNA) 42, another matching network 44, an RF to IF mixer 46 which mixes down the RF signal to the IF range and then provides it to the demodulator in block 14. Demodulator 14 demodulates the transmitted baseband information and provides it to controller 16. Since mixer circuits 30 and 46, LNA 42, and matching networks 32, 40 and 44 are all well known, they are not described in detail herein.

Referring to Fig. 2, a circuit diagram of a digital RF power amplifier 34 designed according to a specific embodiment of the present invention is shown. According to various specific embodiments, amplifier 34 may be designed in accordance with the techniques described in U.S. Patent No. 5,777,512 for METHOD AND APPARATUS FOR OVERSAMPLED, NOISE-SHAPING, MIXED-SIGNAL PROCESSING issued on July 7, 1998, the entire disclosure of which is incorporated herein by reference for all purposes. Amplifier 34 includes a frequency selective network 50 with a high Q at the desired transmission frequency, an analog-to-digital converter (A/D) 52, an output stage 54, and a feedback loop 56 which provides a continuous-time feedback signal from the output stage 54 to the frequency selective network 50. The A/D converter 52 samples the output of the frequency selective network 50 and generates a digital signal at 58 which is provided to the output stage 54. In one embodiment, the A/D converter 52 is a comparator that samples at a frequency (fs) of 3.6 GHz for applications where a transmit band of 900 MHz is desired. In an alternate embodiment, the sampling frequency (fs) can range from a minimum of 1.8 GHz to 3.6 GHz or higher for the transmission of a 900 MHz signal. In general, the sampling frequency (fs) should be at a minimum approximately 2X and preferably at least 4X the desired transmission frequency.

One possible implementation of the output stage 54 includes two transistors T1 and T2, inductors L1, L2, and L3, capacitors C1, C2 and C3, and a pre-driver D. The pre-driver D is configured to buffer signal 58 and to provide signal 58 and its complement to the gates of the transistor T1 and the transistor T2, respectively. The drain of the transistor T1 is coupled to Vcc and the source is coupled to a node A. The capacitor C1 is typically the parasitic capacitor between the source and drain of the transistor T1. The drain of the transistor T2 is coupled to a node B and the source is coupled to ground. The capacitor C2 is typically the parasitic capacitor between the source and drain of the transistor T2. The inductor L1 is coupled between the node A and the node B, and the inductors L2 and L3 are coupled between the capacitor C3 and the nodes A and B, respectively.

During operation, the digital signal 58 generated by the A/D converter 52 transitions between high and low levels in accordance with the information being transmitted. Since the signal 58 and its complement are provided to the gates of the transistors T1 and T2 respectively, one transistor is on and the other is off depending on the state of the signal 58. When the signal 58 transitions low level, for example, T1 turns off and T2 turns on. When this occurs, node A resonates due to the formation of a resonating circuit within the output stage 54. This resonating circuit is

formed by C1, the three inductors L1, L2, and L3, and node B which is pulled to ground through T2. Driver circuit 54 thus in effect contains two separate resonators at nodes A and B. Depending on the state of signal 58, one node resonates while the other is clamped. In one embodiment, the resonators are tuned to resonate at the sampling frequency of 3.6 GHz. This is accomplished by selecting the values of inductors L1, L2, and L3 and capacitors C1, C2 and C3. According to a specific embodiment, C3 is selected to bypass an undesired frequency component outputted from the output stage 54.

The output of the switching stage 54 is provided to the matching network 36 which acts as a bandpass filter operating at the transmit band (e.g., 824-849 MHz). Since the antenna 20 transmits at the 900 MHz band in the above-described embodiment, the "tracking" function of the matching network 36 needs to match this frequency. In one embodiment, this is accomplished by selecting the values of L1, L2, and L3, and C3 so that the resonance circuit has a transfer function looking into matching network 36 of approximately 900 MHz so that the output bit pattern generated by T1 and T2 has an energy component at the transmit band. In other words, the matching network 36 has to provide a signal pass rate sufficient to make sure that the bit pattern has sufficient energy at the transmit band for the impedance of the antenna 20 (which is typically 50 ohms).

In another embodiment, the matching network 36 uses the bond wires on the chip containing the power amplifier 34 and other passive components, to create a matching network to provide optimal power transfer to the antenna 20 and to transform the impedance of the antenna 20 to an impedance where the desired power level can be achieved from a given supply voltage. This requires a relatively high Q filter that has a relatively narrow band. In yet another embodiment, the power amplifier 34 is designed to have a bridged output. In applications where the antenna 20 has a single ended output, a BALUN (balance-to-unbalance) transformer or a passive LC combiner may be used.

One potential problem with the power amplifier 34 when used in a cell phone application relates to the fact that the transmitted power includes switching energy in the receive band which has the potential to desensitize the associated or any nearby receivers. Thus, for both FDD and TDD applications, there are limits relating to the maximum allowable transmit energy in the receive band. The present invention provides a number of solutions for addressing this problem, and has advantages

a frequency selective network for noise shaping an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band;

an analog-to-digital converter coupled to the frequency selective network;

a switching device coupled to the analog-to-digital converter for producing an output signal; and

a feedback path for feeding back the output signal to the frequency selective network to facilitate the noise shaping,

~~The bandpass amplifier of claim 1,~~ wherein the frequency selective network ~~comprises:~~ includes

a first signal path including a first number of transmit band resonators operable to resonate at the transmit band, and a second number of receive band resonators operable to resonate at the receive band; and

a second signal path including a third number of transmit band resonators operable to resonate at the transmit band, and a fourth number of receive band resonators operable to resonate at the receive band; wherein

a difference between the first and third numbers is equal to or less than two; and

a difference between the second and fourth numbers is equal to or less than two.

7. (original) The bandpass amplifier of claim 6, wherein the first and second signal paths have at least one of the receive band resonators in common.

8. (original) The bandpass amplifier of claim 7, wherein the first, second, third, and fourth numbers are one, three, one, and two, respectively.

9. (original) The bandpass amplifier of claim 6, wherein the first signal path is a feedforward path, and the second signal path is a feedback path.

23. (currently amended) A communication system having a bandpass amplifier having a transmit band and a receive band associated therewith, comprising:

a frequency selective network for noise shaping an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band;

an analog-to-digital converter coupled to the frequency selective network;

a switching device coupled to the analog-to-digital converter for producing an output signal; and

a feedback path for feeding back the output signal to the frequency selective network to facilitate the noise shaping,

wherein the first filtering circuitry comprises at least one transmit band resonator operable to resonate at the transmit band, and the second filtering circuitry comprises at least one receive band resonator operable to resonate at the receive band,

wherein at least one of the transmit band and receive band resonators comprises a transconductive element, an inductive element, and a capacitive element, and

~~The communication system of claim 22,~~ wherein the capacitive element comprises a bank of capacitors for tuning the corresponding resonator.

24. (currently amended) A communication system having a bandpass amplifier having a transmit band and a receive band associated therewith, comprising:

a frequency selective network for noise shaping an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band;

an analog-to-digital converter coupled to the frequency selective network;

detecting signal strength of the signal which passes through the selected filter; and

tuning the selected filter in response to the signal strength.

44. (original) The method of claim 43, wherein the tuning comprises modifying capacitance associated with the selected filter.

45. (original) The method of claim 44, wherein the modifying includes selectively coupling at least one of a plurality of capacitors provided in the selected filter; and wherein a variation in the signal strength is determined by comparing a plurality of signal strengths corresponding to different values of the capacitance.

46. (original) The method of claim 43, wherein the selecting includes cutting off electric power supplied to the plurality of the filters except the selected filter.

47. (canceled)

PTO/SB/44 (10-96)
Approved for use through 6/30/99. OMB 0651-0033
Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE


(Also Form PT-1050)

# UNITED STATES PATENT AND TRADEMARK OFFICE
# CERTIFICATE OF CORRECTION

PATENT NO. : 6,798,288 B1

DATED : September 28, 2004

INVENTOR(S) : Jayaraman, et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

**In the Specifications:**

Column 4, line 24, change “an LS antenna” to --an antenna--.

Column 5, line 36, change “and 77 turns” to --and T2 turns--.

Column 5, line 58, change “pattern ie is generated” to --pattern generated--.

Column 5, line 59, change “T1 and T7” to --T1 and T2--.

Column 6, line 10, change “the act that” to --the fact that--.

**In the Claims:**

In line 4 of claim 2 (column 15, line 43) change “noise shaving” to --noise shaping--.

In line 4 of claim 15 (column 17, line 18) change “noise shaving” to --noise shaping--.

In line 2 of claim 26 (column 20, line 9) change “modifying associated” to --modifying capacitance associated--.

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PATENT NO. 6,798,288 B1

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**BEFORE THE OFFICE OF ENROLLMENT AND DISCIPLINE**
**UNITED STATES PATENT AND TRADEMARK OFFICE**

**LIMITED RECOGNITION UNDER 37 CFR § 10.9(b)**

Mr. Haruo Yawata is hereby given limited recognition under 37 CFR § 10.9(b) as an employee of Beyer Weaver & Thomas, LLP to prepare and prosecute patent applications wherein the patent applicant is the client of Beyer Weaver & Thomas, LLP, and the attorney or agent of record in the applications is a registered practitioner who is a member of Beyer Weaver & Thomas, LLP. This limited recognition shall expire on the date appearing below, or when whichever of the following events first occurs prior to the date appearing below: (i) Mr. Haruo Yawata ceases to lawfully reside in the United States, (ii) Mr. Haruo Yawata's employment with Beyer Weaver & Thomas, LLP ceases or is terminated, or (iii) Mr. Haruo Yawata ceases to remain or reside in the United States on an H-1 visa.

This document constitutes proof of such recognition. The original of this document is on file in the Office of Enrollment and Discipline of the U.S. Patent and Trademark Office.

**Expires: January 2, 2007**

Harry I. Moatz
Director of Enrollment and Discipline